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Issues related to the spatial planning of land (including minerals) and water resources

Report of the Secretary-General

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I. Introduction

1. The present report has been prepared in accordance with Economic and Social Council decision 1996/306 and resolution 1999/49. It is based on a previous report of the Secretary-General on this topic (E/C.7/1998/5) which was considered by the Committee on Energy and Natural Resources for Development at its first session, held from 5 to 16 April 1999,[1] and subsequently submitted for the consideration of the Council at its substantive session of 1999. The Council, in its resolution 1999/49 of 28 July 1999, requested the Secretary-General to prepare a revised version of the 1998 report for submission to the Committee at its second session. The Council also requested that the report be made available as a background document on integrated land management to the Commission on Sustainable Development at its eighth session.

2. In accordance with the guidelines set out in resolution 1999/49, section III of the report identifies current and emerging issues in the area of land and water resources management. Section IV analyses particular problems in relation to land and water and the need for an integrated approach and action. Section V puts forward recommendations for improving the spatial planning of land and water resources.

3. In the annex to resolution 1999/49, the Council requested the Secretary-General to take into consideration paragraphs 13 to 30 of the inter-sessional strategy paper (E/C.7/1996/6 and Corr.1) of the former Committee on Natural Resources, wherein concern is expressed that the efforts to implement the recommendations of United Nations water and environment conferences, such as the United Nations Water Conference (Mar del Plata, Argentina, 1977), the International Conference on Water and the Environment (Dublin, 1992) and the United Nations Conference on Environment and Development (Rio de Janeiro, Brazil, 1992), have not kept pace with demonstrable needs to address issues of water and land degradation. This has serious implications for society as a whole and the life-support systems on which it is based. Issues of water quality, water quantity, urbanization and land have profound implications for society, including human health, food security, economic production and biological diversity.

II. The context of degrading land and freshwater resources

4. *The fixed and finite nature of land.* The Food and Agriculture Organization of the United Nations (FAO) Interdepartmental Working Group on Land Use Planning defines land as "... a delineable area of the earth's solid surface, embracing all attributes of the biosphere above and below the surface, the soil and underlying geology, the hydrology, plant and animal populations and human settlements, and the physical results of past and present human activity".[2] The total land area of the world is estimated at about 13 billion hectares, over half of which lies in developing countries. According to FAO estimates, only one tenth of the land area in these countries is currently used for crop production, and much of the agricultural land in industrialized countries is already in production. It is also estimated that 90 per cent of potential new cropland is located in the developing world, of which 95 per cent lies in Africa and South America, while the remaining 5 per cent lies in Central America and the Middle East. Virtually no land is available for expansion in Asia. In addition, productive land is continually being lost to soil erosion, waterlogging and salinity and then partially reclaimed through remedial soil conservation and drainage. In many instances, a considerable proportion of this "land reserve" is under forest or in protected areas and is not readily available for agricultural expansion. In fragile tropical and upland environments, forests and their associated productivity are critical elements in sustaining the asset value of land and water systems and maintaining the flow of economic benefits and environmental services that are derived from them. As a consequence, there is currently limited scope for increasing food production through the expansion of cultivated land area. Meanwhile, the degree to which grain-dependent nations can rely upon imported supplies is also tempered not only by the relatively limited volume of internationally traded grain, but also by the infrastructural constraints to grain distribution. This maintains imperatives for degrees of domestic self-sufficiency and places continual pressure on fragile land resources.

5. *The limited and vulnerable nature of freshwater resources.* The quantity and quality of water flowing across the world's landscapes are inherently limited and vulnerable. The implications for economic

development and the overall environmental integrity of the world's surface water and groundwater systems have been recognized for the past three decades. The Commission on Sustainable Development at its sixth session reaffirmed these concerns on the basis of the report of an expert group meeting held in Harare, in January 1998.[3] The spatial variability of land characteristics combined with the spatial and temporal variability of rainfall poses particular challenges for assuring the flow of consumptive and non-consumptive water services that are derived from the freshwater resource base. The modification of natural hydrological regimes through agricultural practices, withdrawals, diversions, flow regulation and pollution will always induce environmental and economic externalities downstream or down-gradient. There is also increasing call for the in situ values associated with watercourses and aquifers to be maintained not only to preserve amenity and biodiversity values, but also to sustain critical human uses that depend upon maintaining water levels and annual flooding regimes — the productivity of wetland forests is a case in point here.

6. The allocation of scarce water resources among competing uses has fundamental effects on human welfare, socio-economic development and the protection of ecosystems. The provision of adequate amounts of water for basic human needs should be incorporated into the formulation and implementation of policies for water resource development and allocation. In this context, the equitable and sustainable allocation of water resources is an essential element of rural and urban development strategies aimed at poverty alleviation through generation of employment, income and productivity. Such strategies should be based as much as possible upon community participation at the lowest appropriate levels, taking into particular account the role of women in rural and urban communities as ultimate managers of water resources in both household and agricultural use. Such approaches require specific policies to improve local institutional capacity and promote human resources development. Economic evaluations need to consider positive and negative impacts on both human and ecosystem health. To the extent that subsidies are required to maintain public health and equitable access, they should be clearly targeted to the intended beneficiaries and aligned with rural development strategies. Additional funding, targeted mainly to peri-urban and rural areas, may also be required to implement such strategies. The integration of water resources development and management with land-use planning is also essential to promote stabilization of rural populations through the alleviation of rural poverty and promotion of local employment opportunities in the productive use of water and land.

7. *Reaching critical environmental limits.* The degree to which human activity has resulted in degraded land and water systems is well documented in all regions of the world. It is now evident that critical physical limits have been exceeded in instances of wholesale degradation of land systems and irrevocable damage to surface and groundwater systems. Accelerated land and water degradation, including dryland salinity and groundwater pollution, are all occurring at unprecedented scales and intensities and are particularly marked where the pressures of population growth coincide with naturally vulnerable ecosystems. These instances can occur at various scales and can range from, for example, over-withdrawal of freshwater lenses in small island atolls to felling of mountain forests to wholesale reversal of saline balances at the level of shared international river basins. With the exception of massive hydraulic structures, in all cases it is the accumulation of many distributed and highly localized land and water management decisions that tip the balance between natural systems that maintain a degree of integrity and systems that break down.

8. *Spatial aspects of physical and socio-economic linkages.* Land and water systems are intimately linked as much through their physical relationships as the socio-economic settings that depend upon them. The spatial expression of these links is significant since the position of any resource or activity will have implications for down-slope and down-gradient components and the respective users. Of particular concern to the spatial planning is the complex array of human systems of rights over land, its natural attributes and associated natural systems, water in particular. These socio-cultural and political divisions that are spread over naturally occurring physiographic divisions pose particular problems for spatial planning on the basis of the resource itself and have, in many instances, constrained planned development.

9. *Agricultural land-use.* According to recent FAO estimates, while arable land may expand by 90 million hectares by 2010, the harvested area could increase by 124 million hectares through improved cropping intensities, with irrigated land in developing countries

expanding by 23.5 million hectares from the current 186 million hectares. As a result of intensification of land use in areas that are naturally well endowed or can be made so by economically viable human activities, such as irrigation and drainage, there will be a significant decrease in the average rate of land per rural household in the near future. Per capita availability of arable land in developing countries is projected by FAO to nearly half between the late 1980s and 2010, from 0.65 to 0.4 hectares, and that figure is likely to decline even further towards 2050, when the possible adverse impacts of global climatic change on food security may become more accentuated. By contrast, the per capita amount of arable land may increase in industrialized countries given their relatively stagnant population growth. This is likely to lead to the more marginal arable lands being taken out of production as "set-aside" lands to conserve natural systems and provide amenity and recreational values. In addition, approximately half of the 1.8 billion hectares of land in developing countries (excluding China) with rainfed crop potential is located in humid areas (that is, too wet for most crops and rather unhealthy for human settlement) or is considered only marginally suitable for crop production. The possibilities for expansion of land for crop production are therefore relatively limited. Nonetheless, it is generally accepted that world food supplies will have to double between 1995 and 2025 because of continued population growth and expected rises in income. However, in view of the constraints on future land supply, unlike previous decades when expanded land area and increased irrigated area played a major role in increasing agricultural production, most of the rise in future production is expected to come from increased productivity, that is the intensification of production with high-yielding crop varieties rather than changes in water management.

10. *The specific spatial impact of mineral exploitation.* Petroleum, mining and smelting industries have created local environmental effects throughout the world, and in the past have led to acute or chronic pollution of soils and surface and groundwater systems. The effects of mineral exploitation depend upon a variety of factors, such as the chemical composition of the minerals, topography, methods of mining (open pit or underground mining), hydrological conditions and climate, but it is often the case that the environmental effects of mining often extend far beyond the mining site. This is particularly the case for impacted surface and groundwater systems, but it also applies in cases of windblown dust and air pollution. The most serious problem is the release into the environment of harmful trace elements and heavy metals, such as lead, cadmium, arsenic and mercury, which may not only pollute local and regional water resources but can also degrade large land areas, major aquifers and eventually coastal areas. Harmful concentrations of metals can also build up in associated plant and animal life and move up the food chain to affect human health. Heavy metal pollution of water has a number of anthropogenic sources, including mining, processing of ores and particularly leaching from industrial waste dumps and mine tailings. Acidified or saline water enhances metal mobility and draws more heavy metals from mine tailings. It also transforms such metals as lead into a form more readily absorbed into living tissues, thus amplifying the toxic effects of leaching. Pollution of groundwater due to leaching processes, particularly in areas with sulphide ore deposits, can be especially serious since reclamation of the affected aquifers is technically demanding and expensive.

11. *Spatial aspects of land and water degradation.* The impacts of human activity on land and water systems come into sharp focus when the environmental balance breaks down irretrievably as a result of accelerated erosion, salinization, groundwater pollution and other processes whose damage goes well beyond the original source of degradation. Anthropogenic degradation in the form of erosion, salinization, waterlogging, depletion of fossil groundwater, pollution by non-degradable chemical substances, acidification and eutrophication have socio-economic consequences that include a decrease in land productivity for long periods of time and the need to implement costly restoration programmes. The sequential impacts of specific environmental "shocks", such as deforestation, are often manifold, unleashing a cascade of soil, water and geochemical impacts. Soil degradation is the most ubiquitous manifestation of environmental breakdown. Its aggregate economic impact is significant because (a) it undermines productive agricultural systems, (b) natural recuperation may take decades or centuries, and (c) artificial soil rehabilitation is often very expensive. FAO has estimated that one fifth of current irrigated land in the world is already degraded to the extent that crop reproduction is significantly reduced. The impact of deforestation in fragile tropical environments is exposing linked land water ecosystems to ever-increasing degradation. The

role of forestry in land use and in land management techniques should therefore not be underestimated in view of the growing interdependency of forestry and agriculture in the lives of rural communities.

III. Situation analysis: current and emerging management issues

12. *The status of spatial planning for land and water systems.* The role of "master planning" has diminished in the last two decades as shifts from central economic planning to decentralized and participatory forms of governance have occurred. The implementation of master plans has continued in developing countries, but there is very little evidence of master plan updates and reiterations. Meanwhile, the use of productive floodplains and also marginal lands with fragile soils and geotechnical constraints for habitation and agriculture has intensified. Natural system limits have been exceeded in many cases both at local levels and at broader regional/system levels since the mechanization of farming and pumping in the first half of the twentieth century. The risks associated with the development of these land categories are becoming increasingly apparent as major flood events, earthquakes and forest fires impact on human settlement in these risk-prone zones. It should be noted that even without a long-term commitment to spatial planning, the technical tools to plan, implement and monitor physical plans (such as satellite surveillance and geographic information systems technology) have advanced dramatically and have become cheap in relation to other planning and implementation costs.

13. *Separation of natural processes and human impacts.* The separation of human impacts and naturally occurring processes is often difficult to determine and attribute with any precision, particularly when the negative environmental externalities accumulate away from the source of the impact. Natural change can be catastrophic, and although human influence on land and water resources can significantly alter natural regimes in many regions and settings, these impacts have to be evaluated against the background of natural processes, such as erosion and geochemical cycling.

14. *Impact of urbanization and changing demographic structure of rural areas.* Many developing countries are experiencing drift of young mobile populations to urban areas. This trend is well documented in United Nations publications.[4] Economic growth and urban development will lead to further competition among various users for scarce land and water resources. Agriculture will continue to be the most important economic sector and represent the most important user of these resources in many developing countries, including some countries with limited availability of water resources. Hence, policies and programmes affecting the allocation of land and water among competing uses can have a profound impact on urban and rural development, and on the generation and distribution of economic benefits. While the impact of urban dwelling is relatively well recognized and monitored by national authorities, the implications for the demographic structure of rural populations are less certain, but given that it is often the young mobile rural populations that are drawn to urban areas, the human capacity to maintain traditional land management techniques, such as terracing and drainage, is becoming progressively reduced.

15. *Institutional responses.* In general, it is possible to observe that the use of land and water systems entails limited enforcement and compliance of sound natural resource policies. There has often been an overall reliance on structural solutions (for example, increasing storage and flood protection) and a reliance on purely administrative solutions (such as the closure of factories). Despite the current state of affairs, there are some positive aspects that are important to note. Comprehensive policies and enabling legislation (including many detailed regulations) are in place in many countries making a commitment to natural-resource-based policies, but implementation lags behind, impeded as much by the political sensitivity of land and water rights as by the sheer complexity of managing linked natural and socio-economic systems. As had been indicated, land and water issues are multidisciplinary in nature and encompass a large number of other environment and development issues. Although these clearly call for an integrated approach, such issues are often addressed independently through economic sector management and administrative domains. This commonly results in duplication and waste of financial, human and institutional resources and can avoid addressing symptoms and causes across naturally integrated spatial units, catchments, aquifers and river basins. However, the experience with the implementation of natural resource based policies as opposed to sector policies has been limited to a few innovative countries. In general, the vested interests in sector-based policy are often too strong or entrenched

to allow complete commitment to integrated land and water management.

16. *Land tenure and water rights*. The wide variation in systems of rights and tenure over land and water resources presents a major hurdle for spatial planning of land and water. Disputes between traditional (common law) systems of land and water rights and modern administrative systems of land and water are profound.[5] This is the case not only for many developing countries that are highly dependent upon subsistence and commercial farming systems, but equally in more developed regions.[6] As pressures for access to productive land increase, particularly in areas where options to migrate to urban centres are limited, the need to resolve both the political and the structural planning issues becomes more acute. For instance, access to rural credit, agricultural inputs and markets can hinge upon both a recognition of land titles and the availability, *inter alia*, of the necessary infrastructure, rural banks, feeder roads and irrigation delivery. Systems of land and water rights should to a greater extent respect and balance prior common law and also take into account the spatial framework of river basins and aquifers. The degree to which progressive legal reform can promote the sustainable engagement with the natural resource base is as much a question for spatial planners as it is for the drafters of the legislative code.

17. *The valuation of natural resources and environmental services*. The social, economic and environmental values associated with land and water systems are often unrecognized and undervalued. The common property conception of land and associated surface and groundwater resources (irrespective of their legal status — which varies considerably) make the application of traditional economic methods and tools problematic. The use of land and water resources invariably produces externalities that are difficult to capture in conventional market transactions.[7] Therefore, the notion that some form of regulation is required to protect the public interest in the resource base is generally accepted.

18. *The knowledge base*. All countries are facing various degrees of land degradation problems and examples of progressive practice in land and water management can be found in different climatic and physiographic zones. In addition, numerous international conferences, publications and national experiences have provided basic frameworks on which to build effective management plans. The role of geographic information systems technology in monitoring and planning spatial changes in land-use and resource management is now playing a broader role in environmental monitoring and planning as computing systems and software become both more sophisticated and less expensive.

19. *Lagged application of technology*. The report of a panel of the Commission on Science and Technology for Development studying science and technology for integrated land management (E/CN.16/1995/4), submitted as a background document to the Ad Hoc Inter-sessional Working Group on Sectoral Issues (see E/CN.17/1996/6) at the fourth session of the Commission on Sustainable Development, concluded that most of the scientific knowledge and applied technology needed for effective land resources management are available. The same is true for water management, and it is likely that countries with such problems may not be applying this knowledge effectively owing to limited access to information and appropriate technologies, lack of adequate infrastructure to use available technology efficiently and institutional fragmentation, which result in uncoordinated approaches and efforts, lack of scientific and educational capacity, problems caused by current land-use practices and unresolved conflicts between different land-use goals. In addition, the lack of human financial and organizational resources in many countries prevents people from actively participating in environmental management and policy development.

IV. Problem analysis: the need for integrated action

20. *The range of the problem*. The economic productivity of land and water systems has been limited as much by inherent limitations of the systems as by poor management and there is a continuum of actions required at all levels in order to move towards overall sustainability of land and water resources. At the global and regional levels, issues to be addressed include desertification, drought and flood management, as well as other issues related to natural disaster preparedness and prevention. At the regional level, there is also scope for actions to control transboundary pollution of soil and water, cooperation in the conservation and use of international waters (rivers, lakes and groundwater) and river basins, and the

transfer of technology and know-how. At the national level, there is a need to implement policies to promote the sustainable use and management of land and water resources, including with regard to the identification of clear rights to land and water resources. Significant action also needs to be taken at local levels, where local development plans should aim at efficient and sustainable use of existing resources, protection of resources from quality degradation, and strengthening of local participation, especially by women and the poor, through education and public awareness campaigns and greater opportunities for local participation in planning and decision-making processes. A number of issues need to be addressed to ensure an effective integration of land and water resources management.

21. *Causes*. The root cause of land and water degradation is excessive land and water use, emanating from excessive demand in relation to actual supply of resources. The increasing demand and relatively decreasing land and water resource base have resulted in an intensification of competition among various uses in space and time. The whole issue is severely complicated by the population growth, particularly in areas with inherently limited land and water resources. The intermediate causes are twofold. First, the institutional arrangements are fragmented, which calls for integration of approaches. There are few examples of single agencies responsible for the overall environmental health of the land and water resources. Second, with the exception of countries that can, in the short term, import substitute agricultural produce and desalinate and distribute sea water, the economic substitutes for these critical resources are not readily available. However, the prime proximate cause of degradation remains the operational land and water management at the local level, which may not conform to declared policies or may not be subject to any policy direction at all.

22. *Identification of gaps*. It is the intermediate and proximate causes that can be addressed in the short and medium term through clearer articulation of policies and improved implementation. Specific gaps that can be identified and which can be negotiated include:

(a) Lack of incentives for integrated natural resource management policies (the economic argument);

(b) Lack of coherent spatial constituencies at the level of the natural resource base (stakeholders);

(c) Lack of working systems of basin governance (implementation);

(d) Lack of accountability and risk-sharing;

(e) Continued reliance upon structural solutions;

(f) Poor or impeded information flows and lack of relevant information.

23. *Sector-based or natural resource-based management?* The incentives for integration across sectors and jurisdictions are not always made clear since the economic externalities (both positive and negative) generated by the use of the natural resource base can be felt away from the point of use. In this sense, it can be argued that an integrated rather than a sectoral approach is essential to reconcile competing interests and optimize resource use. However, the complexity of valuing natural resource systems over time and space constrains the presentation of explicit economic arguments. It should also be noted that the existence of strong sectoral entities and interests, is not, in itself, sufficient reason to fail to adopt integrated approaches. Efficient coordination across sectors can be achieved if economic and financial incentives are presented to the sector players through an administratively strong resource manager. Here, it is the integration of sector policies and interventions across natural resource units that is critical. This is particularly the case for competition between urban and rural land uses. This conflict can be expressed in various forms, such as (a) expansion of human settlements, industrial areas and peri-urban infrastructure versus protection of prime agricultural land and secure agricultural land tenure, (b) mass influx of rural poor to urban areas versus adequate availability of labour for agricultural activities (or conversely, urban unemployment), (c) competition between urban and rural water use, and (d) urban demand for timber and charcoal versus vegetative protection of upper catchments to prevent the degradation of agricultural land and water resources.

24. *Natural resource constituencies and systems of rights*. It is increasingly clear that conventional options for purely administrative solutions to land and water management appear to have reached their limits. A consensual approach to natural resource management is thus becoming an increasingly attractive solution for

resolving tensions between owners, managers and regulators of resources. However, dealing with complex natural and socio-economic systems will always involve a measure of compromise over the spatial "rules of engagement". Here, the legal status of the natural resource (whether common, public or private) and the system of rights that has developed over time can be difficult to resolve. The "perfect" right to land as a static resource is easier to administrate than user rights over water that flows above or below a bounded area of land. In general, there is a lack of clear, steady boundaries in the water resource flow domain (both surface water and groundwater) that can conform with the generally precise administrative and jurisdictional bounds in the public domain — the so-called "solutions of continuity". While natural resource specialists are always seeking to define physical boundary conditions, these boundaries are, by their nature, dynamic — changing over time and space — and are not generally closely monitored. For instance, the typical "solutions of continuity" that would apply in the regulation of watercourses (catchments and basin boundaries) and the "natural monopoly" conditions that apply in the provision of water services from single sources, such as rivers or dams, are not easily validated for aquifer systems and their multiplicity of users. Equally, if the effects of all groundwater withdrawals fell within accepted and precise administrative solutions (for example, "rules of capture" related to property boundaries), there would be no problem, but this circumstance can rarely be proved to apply. These considerations make the identification of natural resource constituencies, as opposed to administrative constituencies, difficult in both technical and political terms and can thwart attempts to organize around naturally integrated land and water management units.

25. *Effective systems of natural resource governance.* Formulation of integrated land and water policies is constrained by the political realities and sensitivities surrounding, on the one hand, bounded property claims and on the other, access to and use of a common property resource — water. The range of sectoral interests is such that it is very difficult for one institutional agency to undertake overall responsibility for natural resource management. But there are clear opportunities for the formulation of strategic approaches to land and water degradation improved implementation through efficient sectoral coordination. Single natural resource agencies can only be effective here if they have clear mandates and are able to offer compelling incentives to change local systems of land and water management.

V. Actions to improve and enhance the spatial planning of land and water resources

A. Integration of land and water resources management into national socio-economic strategies

26. *Spatial frameworks for reconciling interests.* Effective land and water resources planning, development and management needs to be integrated into overall national economic and social planning and strategies. This can only be done at the appropriate spatial level if there is broad agreement to reconcile interest in the framework of functional natural resource units, river basins, aquifers or homogenous physiographic zones that include a grouping of basins and aquifers with similar characteristics.

27. *Improved economic analysis and incentives.* Estimating the full economic value, including environmental and amenity assets, of land and water poses particular problems, and a range of solutions have been employed by economists and their respective institutions. Some examples on how to place a value on the public good benefits of water are discussed in a recent World Bank report.[8] Economic valuation of water-related investments in development and management of irrigation, hydropower, urban and rural water supply and sanitation, drought prevention and flood control is important because it aids in determining the worth to people of proposed projects and in estimating the degree to which they are willing to pay for benefits. In the prevalent situation of constrained public budgets, conceptually correct and empirically valid estimates of the economic contribution of both land and water in each water-using or land-use sector are essential for making economically sound investment decisions.

28. *Structured approach to "stakeholder participation".* Any policy formulation and implementation need to involve a constituency of stakeholders as early as possible in the process, and should include those that are affected by any action, those who possess knowledge and expertise and those who control the

relevant instruments for successful implementation of policies and actions. It is important that public consultations and feedback are carefully structured to avoid special interests crowding out legitimate voices and to demonstrate that the results of the consultation are squarely internalized by policy and decision makers.

29. *Specific links to agricultural production.* Intensive competition for productive land and limited raw water resources is now becoming a feature of economies dependent upon high contributions from agricultural output. Under these circumstances, agriculture and irrigation policies have to be set into a broader frame of sustainable development to stress the long-term sustainability of food production systems, particularly in relation to soil and water conservation and the role of traditional agricultural practices. For example, the role of shallow groundwater in sustaining rural communities and providing a buffer against annual drought will remain critical in many arid and semi-arid areas but often needs protection from overexploitation by dominant agricultural interests.

30. *Specific links to health.* With water as a primary agent in maintaining both human health and transmitting disease, there is an imperative need to manage land and freshwater sources to maintain chemical and biological quality to minimum acceptable standards. Key actions that will work towards the protection and improvement of water quality include (a) priority for sanitation, sewage treatment and control of discharges of industrial effluents and run-off of pesticides and fertilizers, (b) monitoring of bacteriological and parasitic water-borne diseases at the basin level, and (c) prevention or minimization of contamination of land and water by heavy metals, such as mercury used in artisanal mining.

31. *Protection of vulnerable ecosystems.* The balance between environment and development needs to be founded on a clear understanding of the environmental systems and the resources that they can furnish without compromising their overall long-term integrity. The economic implications of environmental degradation and failure to anticipate climatic variability can account for significant percentages of gross domestic product in lost productivity. As mentioned above, a number of environmentally sound development policies to avoid or mitigate damaging impacts on land and water ecosystems have been formulated by various national and international bodies, including the body of recommendations related to the implementation of the United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa, the Convention on Biological Diversity, the Convention on Wetlands of International Importance, Especially as Waterfowl Habitat (Ramsar Convention) and the Convention on the Law of the Non-Navigational Uses of International Watercourses.

B. Institutional and legal frameworks for effective governance of land and water systems

32. *Establish clear principles of natural resource management.* Worldwide, there are four common threads to be found in dealing with integrated planning and management of land and water resources. First of all, a stable institutional framework that overcomes fragmentation and overlap of responsibilities, supported by comprehensive but flexible legislation and regulations, must be in place. This ensures fairness in basin-wide decisions and a process of accountability. Second, planners and stakeholders should have access to a strong knowledge base grounded in an accurate and comprehensive data network that allows the formulation, implementation and follow-up of sustainable natural resources development strategies. This ensures equity in defining solutions among and between the implementing agencies and water users. Third, various natural resource issues should be fully integrated into coherent administrative frameworks, which implies that responsible agencies have to take into consideration the whole natural resource spectrum of possible positive and negative environmental impacts. It also means that provincial and regional governments should look at their natural resources base as a whole and attempt to achieve sustainability as a package, as opposed to attempting to maximize the use of a single resource, such as water, soil or minerals. Last but not least, a programme for strong community awareness and participation should be fully implemented. Most policies or decisions relative to the rehabilitation or exploitation of natural resources have a large impact on users, especially farmers. Unless the end-user understands these issues and is able to measure his or her behaviour in relation to local sustainability indicators, users cannot be expected to forego short-term gain in pursuit of long-term sustainability.

33. *Address the problem at the appropriate scale.* In order to implement integrated land and water policies, countries need to define appropriate spatial and temporal scales, at both the national and local levels, for the formulation and implementation of relevant development and conservation programmes, including monitoring systems. It is important to recognize that, although the basic problems of land and water management have many similarities around the world, local variations in the physical environment and economic and social conditions require that technological and managerial solutions be adapted to local conditions. For instance, basin management approaches developed for small-scale basins or sub-basins may not be suited to large-scale basins. It is important, however, that national (and to some extent regional) planning take into account the scale of natural resources units — river basins, aquifer systems or coherent physiographic zones. As a first step, this can be done within existing institutions, by coordinating planning strategies and adapting them to the required spatial level. Establishing a focal point within national and subnational administrations would facilitate this process. In addition, there is a need for political initiatives and economic incentives that promote consultation and coordination among the actors. Despite the fact that interdepartmental coordination within national and local administrations would be an important step in making land and water management planning more efficient, the efficient integration of land and water resources may require the establishment of specialized agencies that have specific responsibilities for planning across administrative and sectoral jurisdictions.

34. *Make provision for implementation through local management.* Local management institutions need to be given a high degree of responsibility over the planning and use options of land and water resources under their jurisdiction, including the resolution of disputes among competing water and land uses, particularly where economic instruments either have failed or cannot be applied. If not already available, an inventory of local land and water resources should be compiled, and the economic, social and environmental requirements of all stakeholders need to be identified. The role of local farming and water user associations is becoming increasingly recognized here and they clearly need to be encouraged to engage in the planning process. Accommodating these special interests in an open and transparent planning process is desirable and potentially can be an effective route to sustainable development.

35. *Build requisite capacities.* The relevant chapters of Agenda 21 recognize that many of the problems related to land and freshwater have arisen from a lack of adequately trained personnel, public awareness and education about the protection of surface and groundwater resources. Since extension services have traditionally been provided by sectoral institutions without proper coordination, starting to build the institutional capacity to deliver integrated services at the field level requires, above all, both high-level ministerial policy coordination and appropriate financial and human resources. Applying a multidisciplinary mix may need a refocusing of efforts at intermediate institutional levels and extensive retraining of extension officers. These efforts should ideally be supported not only by international, national and local support agencies, but also by the private sector and various non-governmental and scientific organizations. The strengthening of institutional capacity also requires a strong educational, research and analytical infrastructure, primarily based on local and national expertise. Educational capacity needs to be built from a strong base, including primary education. At the national level, considerable efforts need to be made to promote the understanding of the interaction between land use and management on the one hand, and quality and flow regimes of river systems and groundwater on the other. This is particularly important in rural areas, since non-point sources of pollution, including fertilizers and various toxic substances used in agriculture, are an increasingly serious problem worldwide. The scientific community, through universities and international organizations, has a responsibility to gather and present information that is accurate and comprehensive, and to provide practical assistance in the implementation of action-oriented programmes and initiatives. At the same time, Governments should promote and enhance the active participation of scientists in the policy and decision-making process.

36. *Promote public information campaigns.* As a complement to education programmes, public information campaigns are an important way of communicating with large groups in society. These campaigns should be based on information that is readily available and comprehensible to the general public, and should aim at promoting broad public

interest in environmental issues. It is important that such campaigns be presented in a positive manner, demonstrating possible development options of interest to people at the local level. The technical revolution within the information and communication media (principally the Internet) has enabled the cheap dissemination of vast amounts of information on land, water and other environmental issues. This, however, has not yet benefited many people in developing countries that presently lack the means to access these services. In order to be disseminated worldwide, assistance to develop national networks in developing countries is required to improve and enhance (but not replace) ongoing public extension programmes.

C. Mobilization of financial resources

37. The mobilization of the financial resources to implement the land and water planning initiatives indicated above presents a set of challenges. Despite the fact that developing countries and countries with economies in transition have been working towards the sustainable financing of traditional subsectors, such as urban water supply and irrigation, they have not yet come to fruition. At the same time, they also face enormous financial, technical and institutional challenges in managing their water and land resources in a sustainable and integrated manner. The quality of the intertwined land and aquatic environment is a concern in all countries, but in many developing countries, the situation is acute. This is most obvious in cities where sewage and industrial effluents are rarely treated. There are also very major problems associated with inappropriate land and water use in agriculture. The financial resources required to deal adequately with these problems are often beyond the means of most countries. While official development assistance is an important source of finance in the poorest countries, in most developing countries, the bulk of investments required to tackle these problems will have to come from national sources. In order for this to happen, Governments need to foster an enabling environment that encourages investments from both public and private sources, and to allocate a significantly higher proportion of their budget expenditures to public investments in sanitation and sewage treatment in order to control the adverse environmental health impact on both land and water ecosystems. This will often include measures to ensure cost recovery of improved service provision. In fact, greater attention needs to be given to the use of economic instruments, such as pollution charges and taxes on fertilizers and pesticides, to control the discharge of industrial effluents and non-point sources of pollution in agriculture. As discussed in a paper prepared for an expert group meeting on strategic approaches to freshwater management held at Harare in January 1998, it is possible to identify two major approaches to dealing with environmental standards and the costs required to achieve those standards. The first approach can be characterized as the "set-the-standards-and-then-raise-the-money" approach. The second approach is one in which environmental quality and the required financing are considered simultaneously.

D. Transfer and adaptation of technologies

38. The efficient management of land and water resources is mostly a local or national issue, and will need to be defined for each area. Local and indigenous experience can be an important source of knowledge that is often ignored in traditional technical cooperation arrangements. Research into and adaptation of such knowledge for contemporary application can yield results that are cost-effective and sustainable. It is also important that technologies and training or education programmes be adapted to local conditions and local users. Appropriate technologies to improve land and water management exist, but their applications are limited by institutional and financial constraints, as well as lack of appropriate training and education. Transfer of technology is not automatically a solution to the underlying problems facing many countries, such as increased population pressure and land degradation, but it can be an important component in combination with many other actions that might be needed, including measures to ensure adequate operation and maintenance at the local level.

39. Technology transfer schemes should also recognize that ongoing technological development is often driven by commercial considerations, so that investment in further research and development can be properly funded. Nonetheless, the least developed countries that have not benefited from the increase in private capital inflow need special attention. To address this issue, priority could possibly be given to low-cost technologies and the use of local resources, including

raw materials, that could be promoted as environmentally feasible.

E. Enhanced information management and monitoring systems

40. *Information for economic performance.* The continuous monitoring of environmental changes is crucial for economic and social planning at both the national and regional levels. The adaptation to changes (natural as well as human-induced) that take place in the landscape requires that information on such changes be periodically gathered and analysed. It is useful, however, to note that the financial costs of establishing, operating and maintaining monitoring systems can be high and beyond the means of many developing countries unless financial and technological assistance is provided. This calls for careful cost-benefit analyses that take account, *inter alia*, of the limitations of these systems and the possible benefits that they will provide, including (a) the provision of adequate and accurate information to decision makers, (b) the ability to detect changes in the landscape, including natural or human-induced disasters, so that appropriate measures can be taken to deal with them, and (c) the ability to detect natural and man-made disasters so that appropriate action can be taken to prevent them or the mitigating effects that follow them.

41. *Information for risk management.* Disasters, natural as well as human-induced, are often related to land and water systems, such as floods, droughts and mudflows. When they occur, there is a need for rapid and coordinated responses and actions from local, national and international organizations. If data and information are available and continuously updated, changes that may eventually cause irrevocable loss of productivity, such as deteriorating water and soil quality, critical changes in groundwater piezometric heads, topsoil loss, floods and mudflows, may be detected and action can be taken in advance. National and regional capacity to gather and evaluate information that is relevant to disaster prevention needs to be strengthened, including through international financial and technological assistance, if required. In this sense, the role of risk management for natural resources needs to be embedded in national policies and recurrent budget resources dedicated even when the short- and medium-term benefit of such investments may not be apparent.

42. *Promotion of exchange and integration of scientific information.* Any monitoring programme developed to study relationships between land and water needs to be cross-sectoral, both within the scientific community and between researchers and policy makers, in order to present a comprehensive set of policy options to decision makers. Comprehensive studies on the reasons behind poor land and water management practices should not only focus on physical constraints in the environment but should also examine pricing policies, land access issues, subsidies, taxes, environment laws, the role of land and water resources in economic and social development, local customs and indigenous knowledge. There is also a need to have an open discussion on further data needs and how to integrate information systems to better address environment issues related to land and water management. The question of addressing issues from a river basin perspective fall into this category. Governments and organizations have ambitious programmes but information, if available, is often scattered and sectoral, which makes it difficult to prepare detailed assessments and propose effective management strategies. It is also important to define data and information needs for each country and region within countries since areas with a complex and changing environment or where land use is intensive will require dense monitoring systems, while more homogenous and sparsely populated areas may require less coverage. The overall objective should be that countries and international organizations should enhance ongoing efforts, both national and international, to collect and analyse data and information about the physical, economic and social environment that can be applied to the watershed level (or any other appropriate spatial level). Financial and technical assistance should be given to developing countries to formulate and implement national programmes in the area of data collection, analysis and exchange. National geographical information systems should be particularly developed and supported, and their databases should be systematically updated and expanded, as required. Scientific cooperation among universities could be one step in the right direction. It could be possible from this system to retrieve information and data sets on physical, economic, social, and environmental conditions and parameters, and to integrate them at the desired spatial scale, for example covering a specific river basin or sub-basin.

Notes

[1] See *Official Records of the Economic and Social Council, 1999, Supplement No. 12* (E/1999/32).

[2] Food and Agriculture Organization of the United Nations and United Nations Environment Programme, "Negotiating a sustainable future for land: Structural and institutional guidelines for land resources management in the 21st century", Rome, 1997.

[3] See the report of the Expert Group Meeting on Strategic Approaches to Freshwater Management (Harare, 27-30 January 1998) (E/CN.17/1998/2/Add.1).

[4] United Nations *World Urbanization Prospects: The 1996 Revision*, United Nations publication (sales No. 98.XIII.6).

[5] D. A. Caponera, *Principles of Water Law and Administration*, Balkema, (Rotterdam, 1992).

[6] B. Barraqué, *Eurowater: Water Rights and Administration in Europe*, European Union D.G.XII Horizontal Report No. 8, 1996.

[7] National Research Council, *Valuing Ground Water: Economic Concepts and Approaches*, Committee on Valuing Groundwater (Washington, D.C., National Academy Press, 1997).

[8] Robert Young, "Measuring the Economic Benefits for Water Investments and Policies", World Bank Policy Paper, No. 338 (Washington, D.C., 1996).